



Lyndon B. Johnson Space Center

MAN-SYSTEMS DIVISION

J. L. LEWIS, PhD / SP

MAN-SYSTEMS DIVISION

MAN-SYSTEMS DISTRIBUTED SYSTEM FOR SPACE STATION FREEDOM

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OVERVIEW

MAN-SYSTEMS DIVISION

J. L. LEWIS, PhD / SP

1. DESCRIPTION OF MAN-SYSTEMS

- DEFINITION
- REQUIREMENTS
- SCOPE
- SUBSYSTEMS
- TOPOLOGYS

2. IMPLEMENTATION

- APPROACH
- TOOLS

3. MAN-SYSTEMS INTERFACES

- SYSTEM TO ELEMENT
- SYSTEM TO SYSTEM

4. PRIME/SUPPORTING DEVELOPMENT RELATIONSHIP

5. SELECTED ACCOMPLISHMENTS

6. TECHNICAL CHALLENGES



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MAN-SYSTEMS: DEFINITION	MAN-SYSTEMS DIVISION	
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<p>CREW INTERFACES WITH SYSTEMS AND EQUIPMENT</p> <ul style="list-style-type: none">• REQUIREMENTS DEFINITION AND INTEGRATION• HARDWARE• DESIGN, DEVELOPMENT, TEST, AND EVALUATION• SUBSYSTEM MANAGEMENT• OPERATIONAL SUITABILITY ASSESSMENT		



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MAN-SYSTEMS REQUIREMENTS		MAN-SYSTEMS DIVISION
		JIM LEWIS
PROGRAM LEVEL DOCUMENTS		
<ul style="list-style-type: none">• PROGRAM DEFINITION REQUIREMENTS DOCUMENT, SSP 30000• ARCHITECTURAL CONTROL DOCUMENT: MAN-SYSTEMS, SSP 30257• BASELINE CONFIGURATION DOCUMENT<ul style="list-style-type: none">• HAB MODULE• LAB MODULE• LOG MODULE• NODES• AIRLOCK• TRUSS• INTERFACE REQUIREMENTS DOCUMENT<ul style="list-style-type: none">• ELEMENT-TO-ELEMENT• SYSTEM-TO-SYSTEM• SYSTEM-TO-ELEMENT• MAN-SYSTEMS INTEGRATION STANDARD, NASA STANDARD 3000, VOL IV		
PROJECT LEVEL DOCUMENTS		
<ul style="list-style-type: none">• PRD, JSC 31000• SRD-0001• ELEMENT CEI SPECIFICATIONS		
SYSTEMS INTEGRATION MANAGEMENT DOCUMENTS		
<ul style="list-style-type: none">• MAN-SYSTEMS INTEGRATION PLAN• CREW COMPARTMENT CONFIGURATION DRAWING• HUMAN COMPUTER INTERFACE GUIDE• DATA BASE DEVELOPMENT AND CONFIGURATION MANAGEMENT		



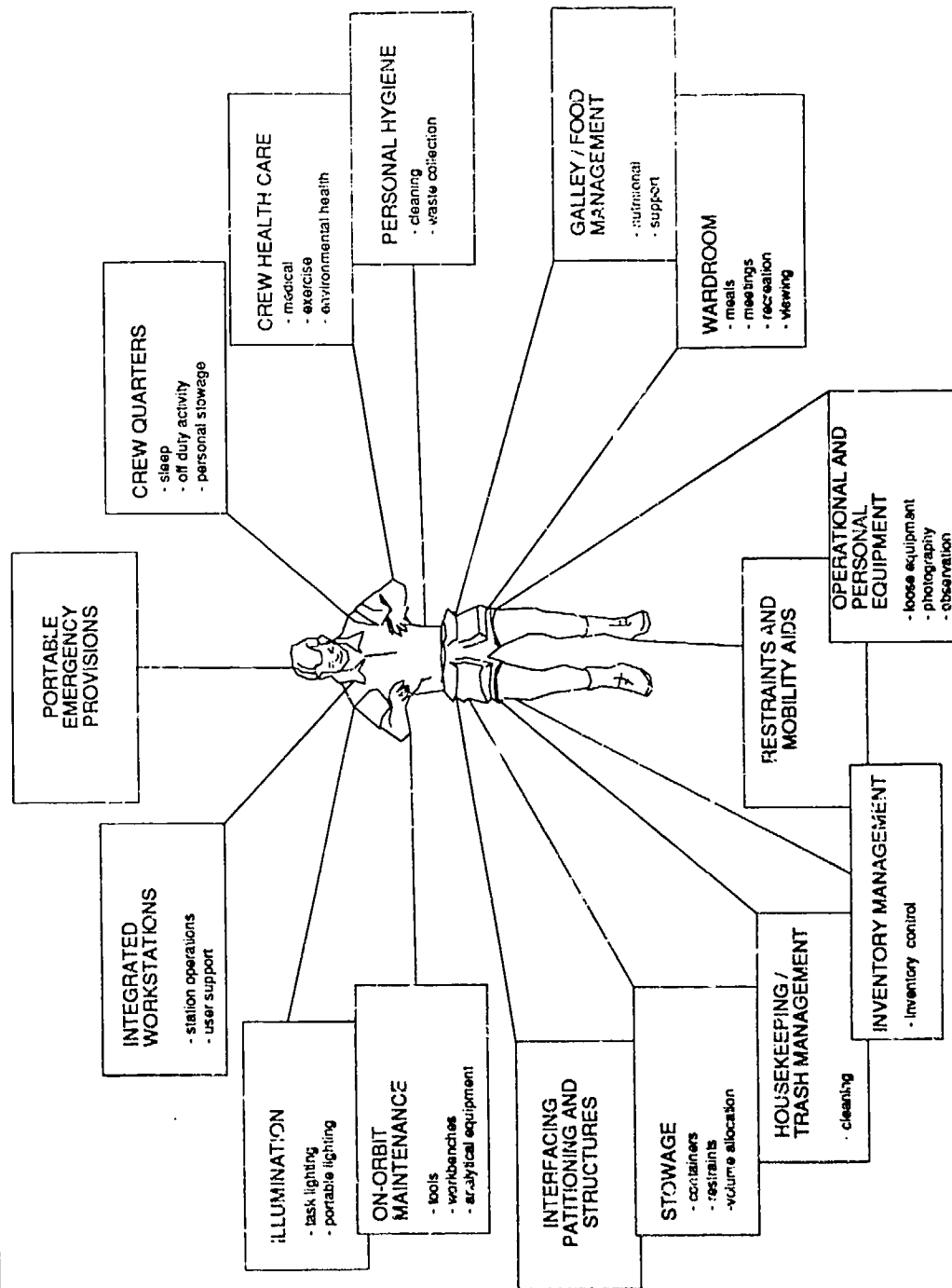
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MAN-SYSTEMS: SCOPE		MAN-SYSTEMS DIVISION
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<p>MAN-SYSTEMS DISCIPLINE PERSONNEL DEFINE AND INTEGRATE MAN-SYSTEMS REQUIREMENTS FOR ALL U.S. AND INTERNATIONAL ELEMENTS. THE MAN-SYSTEMS DISCIPLINE INCLUDES TERMS VARIOUSLY REFERRED TO AS HUMAN FACTORS, HUMAN ENGINEERING, ERGONOMICS, MAN-MACHINE INTERFACE, AND MAN-MACHINE ENGINEERING.</p> <p>IN ADDITION, MAN-SYSTEMS TECHNICALLY MANAGES:</p> <div><div>MAN-SYSTEMS HARDWARE DEVELOPMENT AND ASSOCIATED HUMAN ENGINEERING</div><div>} WP-01</div></div> <div><div>FLIGHT CREW INTEGRATION CREW HEALTH CARE SYSTEM DEVELOPMENT NODE AND CUPOLA OUTFITTING</div><div>} WP-02</div></div> <div><div>FLIGHT TELEROBOTICS SERVICER<ul style="list-style-type: none">• WORKSTATION DEFINITION• CREW INTEGRATION• OPS SUITABILITY ASSESSMENT</div><div>} WP-03</div></div> <p>AS SUPPORTING DEVELOPMENT MAN-SYSTEMS FURNISHES:</p> <ul style="list-style-type: none">• CREW EQUIPMENT• INTEGRATION AND ANALYSIS• MOCKUPS AND TRAINERS		

MAN-SYSTEMS SUBSYSTEMS

MAN-SYSTEMS DIVISION

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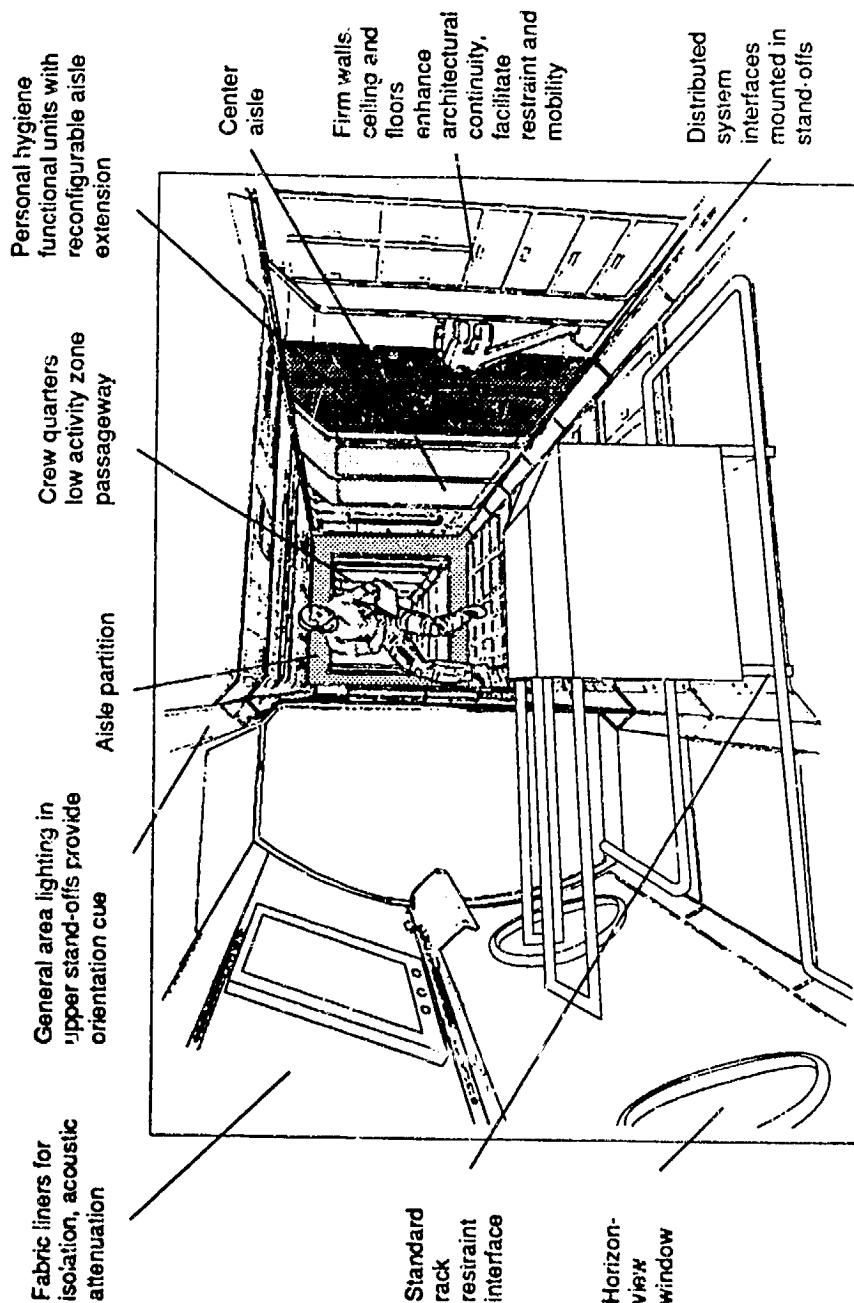


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MAN-SYSTEMS ARCHITECTURAL CONSIDERATIONS

MAN-SYSTEMS DIVISION

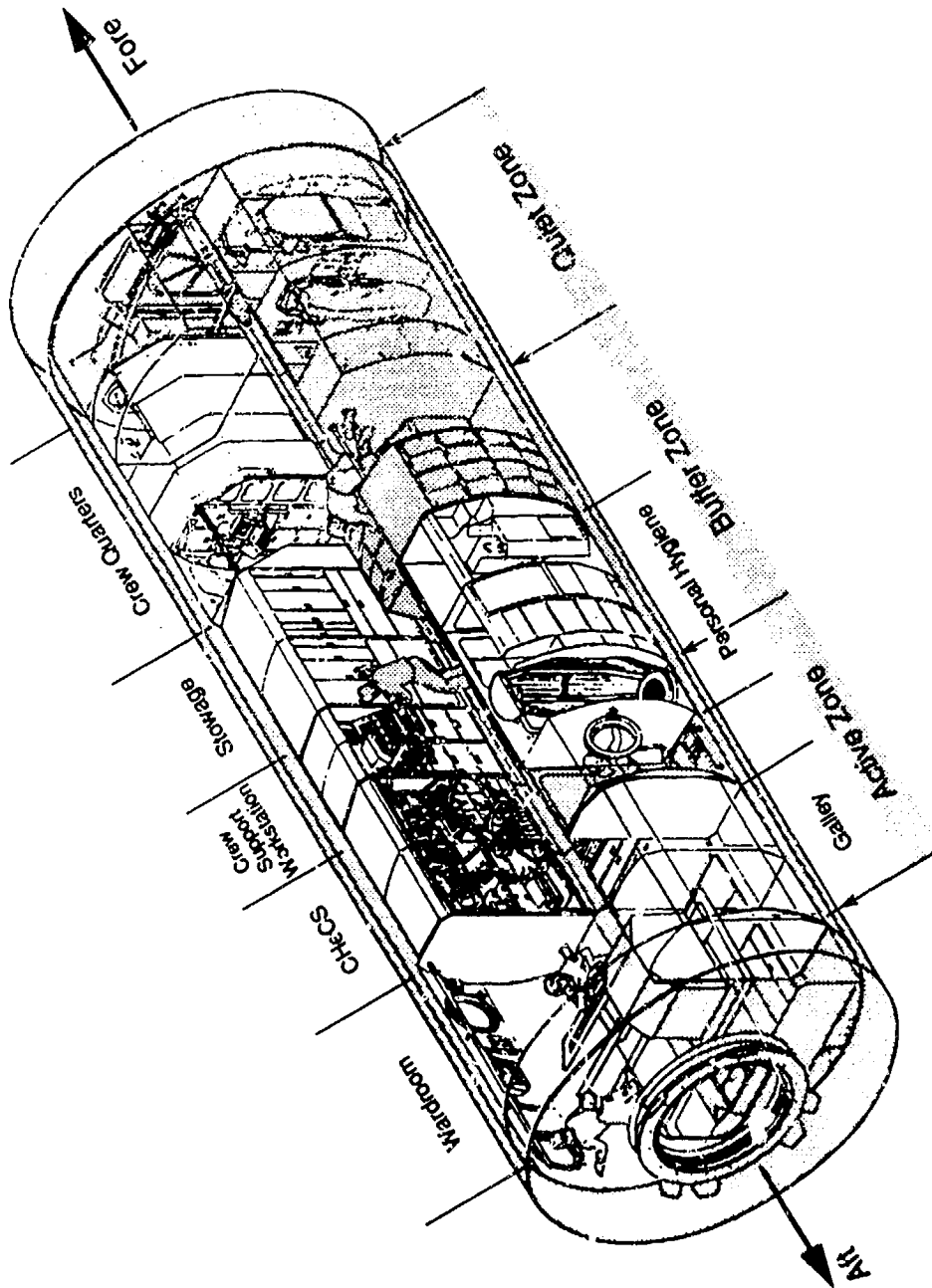
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HABITATION MODULE

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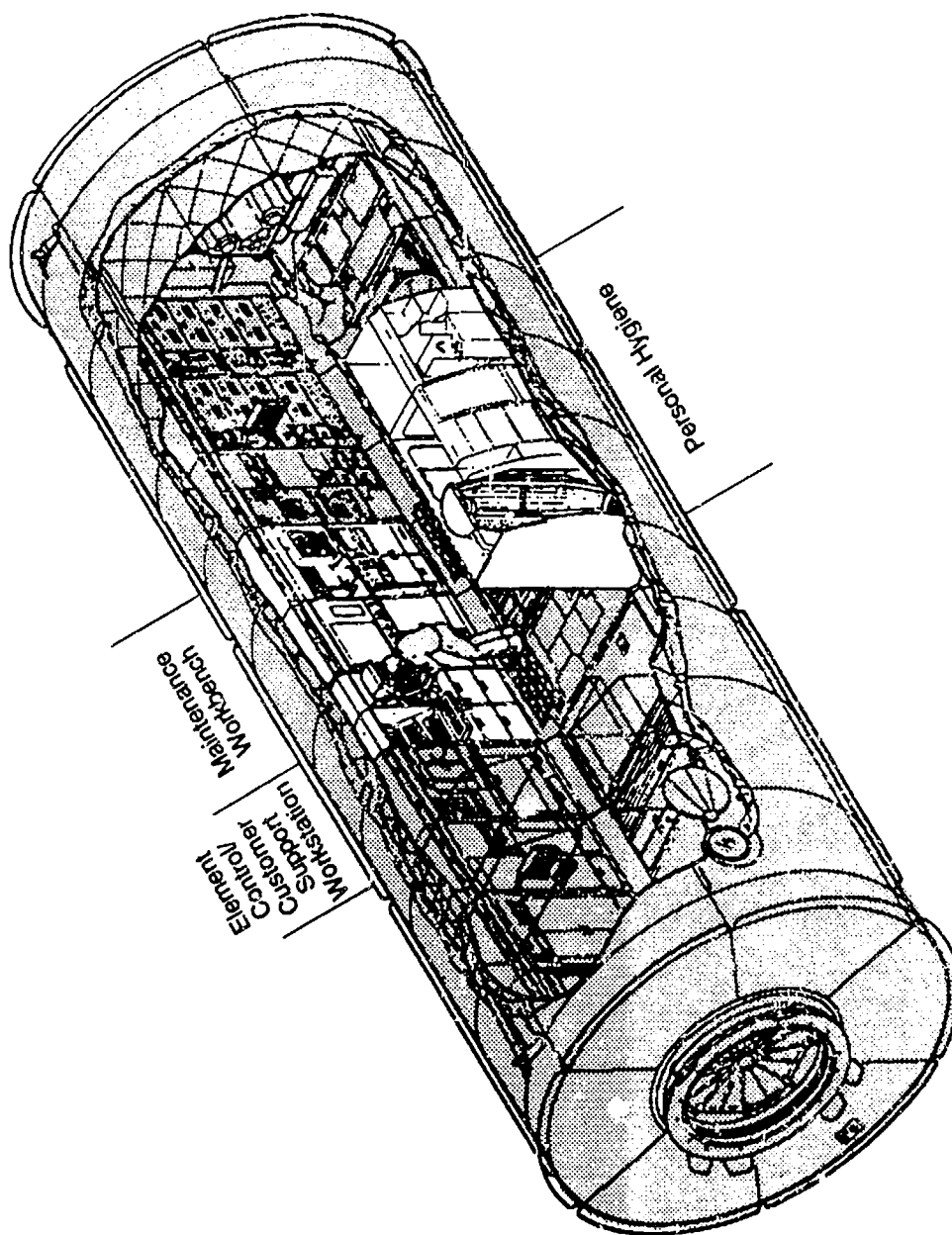


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MAN-SYSTEMS, LABORATORY MODULE (TYPICAL)

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MAN-SYSTEMS SUBSYSTEMS

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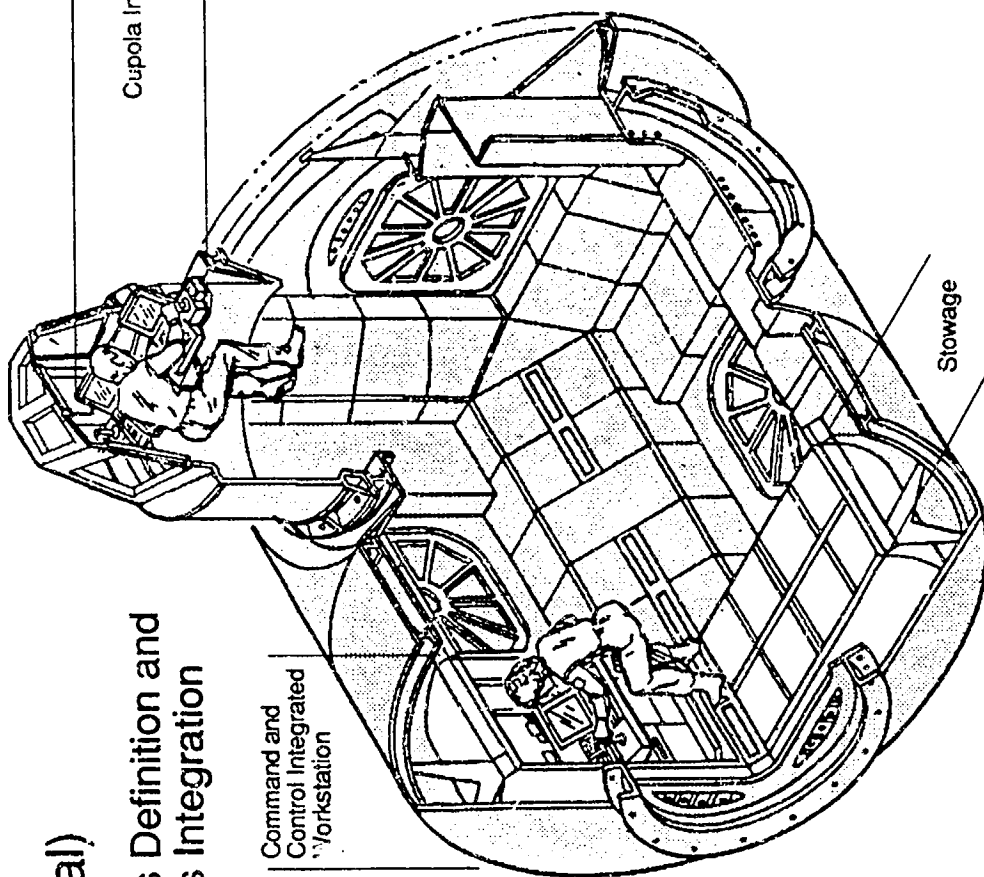
Node (typical)

Requirements Definition and
Requirements Integration

Cupola Integrated Workstation

Command and
Control Integrated
Workstation

Stowage



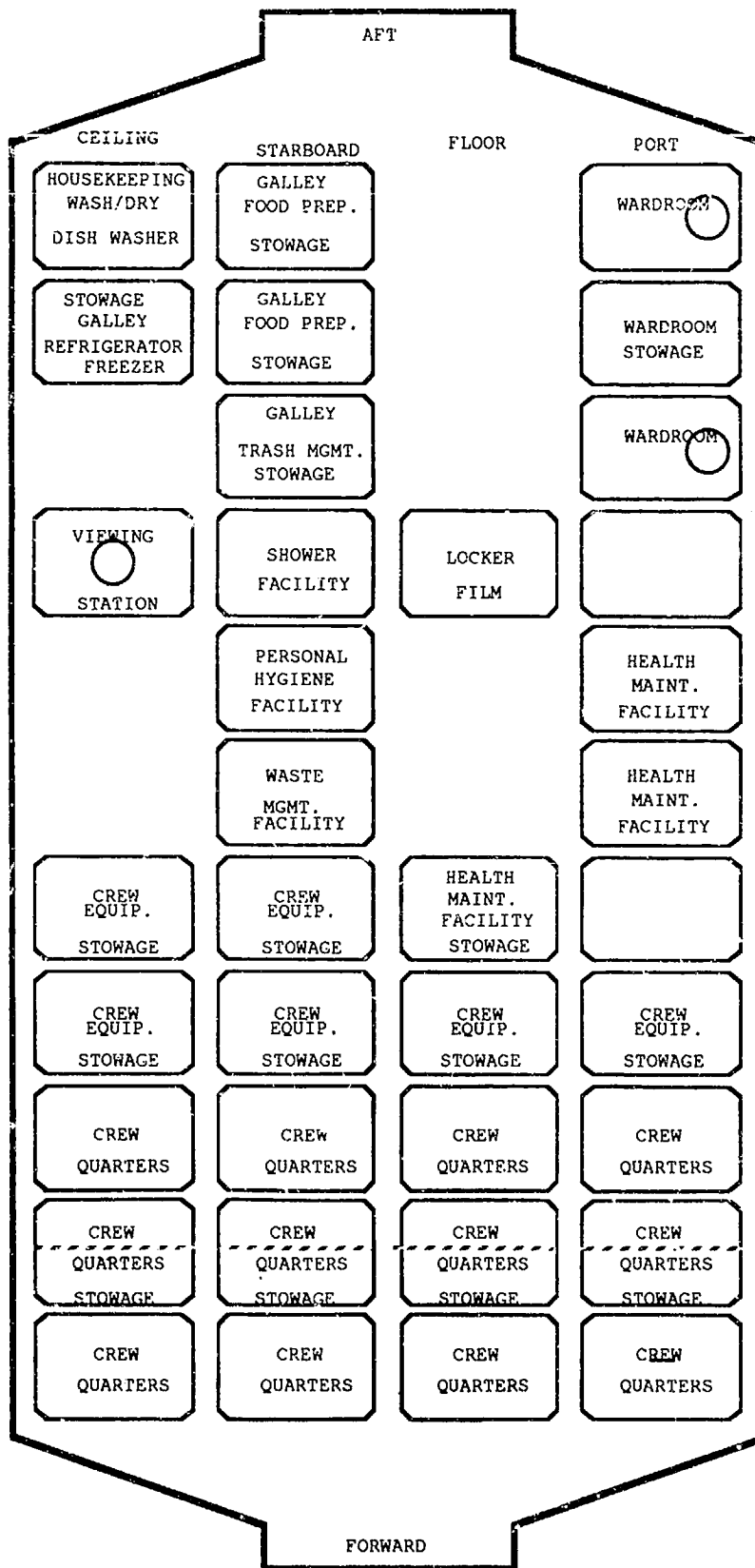


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U.S. HAB TOPOLOGY



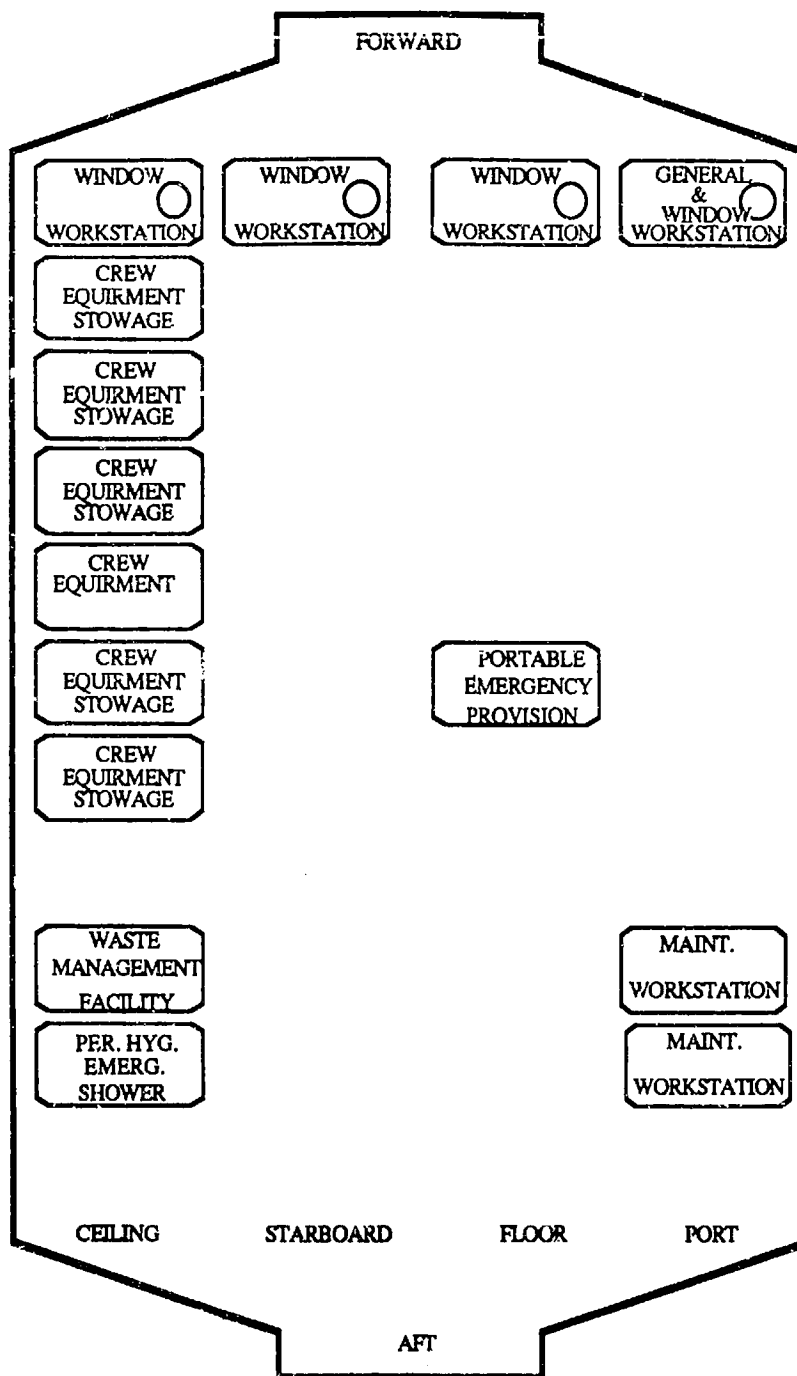
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PRELIMINARY TOPOLOGY HABITATION MODULE

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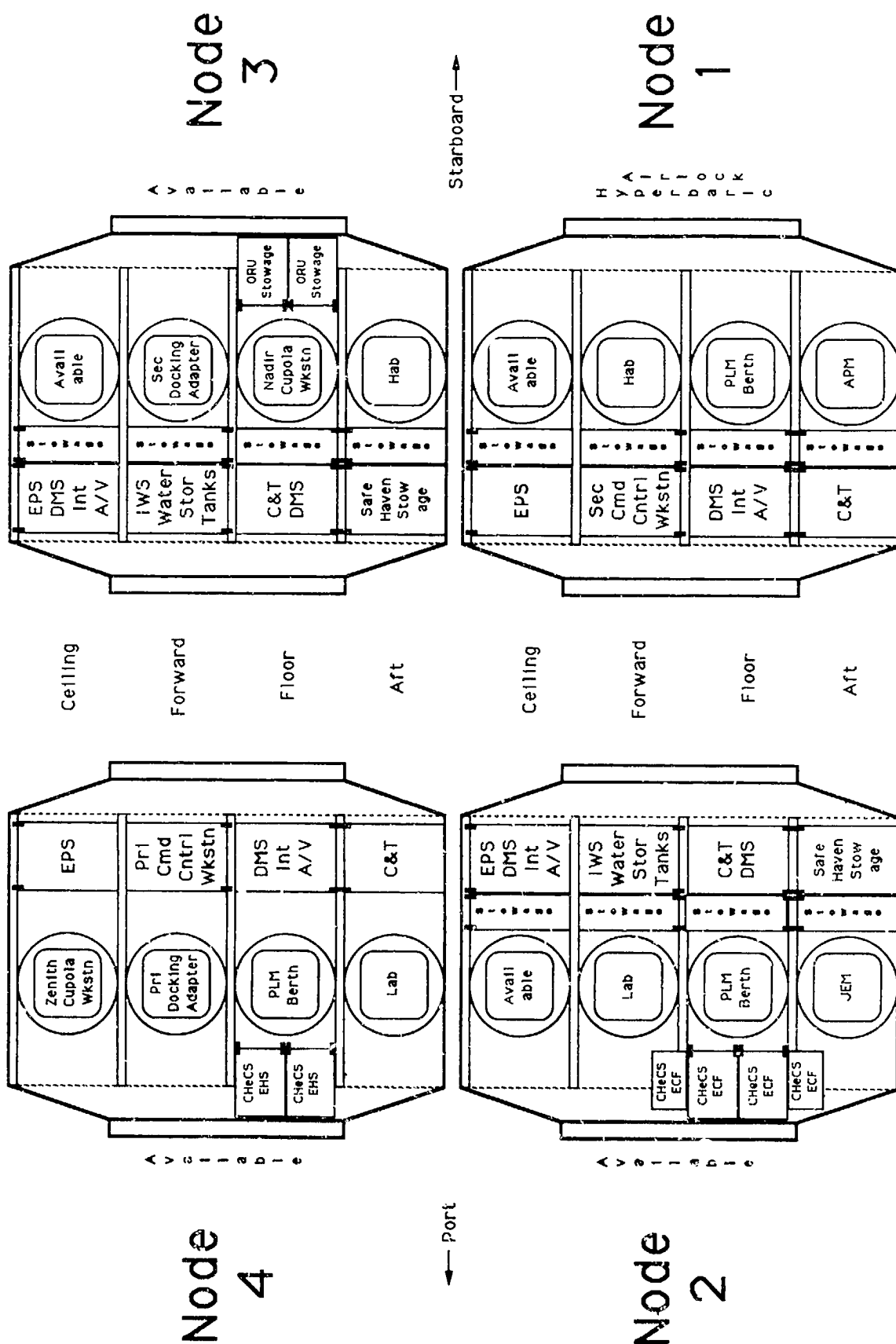
U.S. LAB TOPOLOGY



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PRELIMINARY TOPOLOGY U. S. LABORATORY MODULE

PRELIMINARY AC NODE TOPOLOGIES





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IMPLEMENTATION: APPROACH

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TO PROVIDE PERSONNEL, TOOLS, AND FORUMS TO FACILITATE

THE INTEGRATION OF ALL CREW INTERFACES ACROSS ALL SPACE

STATION ELEMENTS AND SYSTEMS SO AS TO INCREASE CREW

SAFETY AND PRODUCTIVITY.



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IMPLEMENTATION: TOOLS	MAN-SYSTEMS DIVISION
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<div>MAN-SYSTEMS INTEGRATED TEST BED</div> <div><ul style="list-style-type: none">• WEIGHTLESS ENVIRONMENT TRAINING FACILITY• NEUTRAL BUOYANCY LABORATORY• SPACE STATION MOCKUP AND TRAINER FACILITY• MOBILE REMOTE MANIPULATOR DEVELOPMENT FACILITY</div> <div>HUMAN COMPUTER INTERFACE LABORATORY</div> <div><ul style="list-style-type: none">• DEFINES REQUIREMENTS FOR OPTIMIZED INTERACTIONS BETWEEN HUMANS AND COMPUTERS• WORKSTATION DESIGN• DISPLAY CONTENT AND FORMAT AND USE OF TEXT AND GRAPHICS</div>	



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IMPLEMENTATION: TOOLS		MAN-SYSTEMS DIVISION
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GRAPHICS ANALYSIS FACILITY <ul style="list-style-type: none">• PERFORMS SYSTEMS ENGINEERING ANALYSES OF MAN-MACHINE INTERFACES, FLIGHT OPERATIONS, VEHICLE AND PAYLOAD DESIGN, AND MISSION PLANNING• UTILIZES INTERACTIVE CUSTOMIZED 3-D COMPUTER GRAPHICS PACKAGE (PLAID)• INCLUDES UNIQUE MAN-MODELING SOFTWARE WITH EXTENSIVE ANTHROPOMETRIC DATA BASE		
ANTHROPOMETRIC AND BIOMECHANICS LABORATORY <ul style="list-style-type: none">• QUANTIFIES HUMAN PERFORMANCE CAPABILITIES UNDER SHIRTSLEEVED AND SPACESUITED CONDITIONS• MEASURES STRENGTH AND MOTION IN ONE-G AND SIMULATED ZERO-G CONDITIONS (VIA NEUTRAL BUOYANCY AND KEPLERIAN FLIGHT)• MEASURES STATIC AND DYNAMIC ANTHROPOMETRY (STATURE AND REACH ENVELOPES)		



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IMPLEMENTATION: TOOLS	MAN-SYSTEMS DIVISION	
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<p>LIGHTING LABORATORY</p> <ul style="list-style-type: none">• PERFORMS ANALYSES OF FACTORS RELEVANT TO THE ASTRONAUT'S ENVIRONMENT• AMBIENT AND SPECIAL LIGHTING NEEDS ARE ACCESSED FOR BOTH IVA AND EVA ACTIVITIES• EVALUATES DESIGN CONCEPTS FOR LIGHTS, ALIGNMENT AIDS, DOCKING TARGETS, ETC. <p>MAN-SYSTEMS TELEROBOTICS LABORATORY</p> <ul style="list-style-type: none">• PERFORMS RESEARCH CONCERNING HUMAN INTERFACES WITH MANIPULATOR/TELEROBOTIC/ROBOTIC SYSTEMS• SUPPORTS DEVELOPMENT OF THE FLIGHT TELEROBOTIC SERVICER PROGRAM• DEVELOPS MAN-MACHINE REQUIREMENTS, CONCEPTUAL DESIGN INPUTS, AND DESIGN EVALUATIONS FOR TELEROBOTIC WORKSTATIONS, ROBOT DESIGN, AND ROBOT SENSOR SYSTEMS		



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FOOD SYSTEMS ENGINEERING FACILITY

- DEVELOPMENT OF SPACE STATION FOOD SYSTEM AND ANCILLARY EQUIPMENT
- DEVELOPMENT OF FOOD PRESERVATION TECHNIQUES, EXTENDED SHELF LIFE STUDIES, OPTIMUM STORAGE METHODS, FOOD HEATING TECHNOLOGY, FOOD HANDLING EQUIPMENT DESIGN, AND PROCESSING AND PACKAGING TECHNIQUES

ELECTRONIC STILL CAMERA LABORATORY

- RESEARCH AND DEVELOPMENT OF HIGH RESOLUTION DIGITAL CAMERA SYSTEM
- FABRICATION AND TESTING OF PROTOTYPE AND PROTOFLIGHT DIGITAL CAMERA SYSTEMS
- DEVELOPMENT OF IMAGE PROCESSING SYSTEMS TO SUPPORT THE HIGH RESOLUTION DIGITAL CAMERA SYSTEM



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<p>PERSONAL HYGIENE/HOUSEKEEPING LABORATORY</p> <ul style="list-style-type: none">• DEVELOPMENT OF PERSONAL HYGIENE/HOUSE KEEPING SOFTGOODS AND CONSUMABLES• DEVELOPMENT OF THE PERSONAL HYGIENE/HOUSE KEEPING ASSOCIATED HARDWARE• ONE-G AND ZERO-G TESTING OF THE HARDWARE AND ASSOCIATED CONSUMABLES		



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MAN-SYSTEMS INTERFACES

MAN-SYSTEMS DIVISION

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SYSTEM TO ELEMENT

	HAB	LAB	LOG	ESA	JEM	NODES	AIRLOCK	HAL
RESTRAINTS MOBILITY AIDS	●	●	●	●	●	●	●	●
WARDROOM	●		●					
GALLEY/FOOD MANAGEMENT	●		●					●
PERSONAL HYGIENE	●	●	●					●
CREW HEALTH CARE	●	●	●	●	●	●	●	●
STOWAGE	●	●	●	●	●	●	●	●
PORTABLE EMERGENCY PROVISIONS	●	●	●	●	●			
CREW QUARTERS	●		●					
OPERATIONAL PERSONAL EQUIPMENT	●	●	●	●	●	●	●	●
HOUSEKEEPING/TRASH MANAGEMENT	●	●	●	●	●	●	●	●
ILLUMINATION	●	●	●			●	●	●
ON-ORBIT MAINTENANCE	●	●	●	●	●	●	●	●
INTERFACING PARTITIONS STRUCTURES	●	●	●	●	●	●	●	●
INTEGRATED WORKSTATIONS	●	●	●	●	●	●	●	●
INVENTORY MANAGEMENT	●	●	●	●	●	●	●	●



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MAN-SYSTEMS INTERFACES		MAN-SYSTEMS DIVISION						
		JIM LEWIS						
SYSTEM TO SYSTEM	POWER	DMS	THERMAL	C & T	GN & C	EVA	ECLSS	FLUIDS
RESTRAINTS MOBILITY AIDS								
W/ADROOM								
GALLEY/FOOD MANAGEMENT								
PERSONAL HYGIENE								
CREW HEALTH CARE								
STOWAGE								
PORTABLE EMERGENCY PROVISIONS								
CREW QUARTERS								
OPERATIONAL PERSONAL EQUIPMENT								
HOUSEKEEPING/TRASH MANAGEMENT								
ILLUMINATION								
ON ORBIT MAINTENANCE								
INTERFACING PARTITIONS STRUCTURES								
INTEGRATED WORKSTATIONS								
INVENTORY MANAGEMENT								



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PRIME/SUPPORTING DEVELOPMENT RELATIONSHIP					MAN-SYSTEMS DIVISION			
					JIM LEWIS			
SUBSYSTEMS	SSM	WP 01 MSFC	WP 02 JSC	WP 03 GSFC	SPRT DEV	INT'L		
1 CREW QUARTERS	L. WEAVER	X			X			
2 RESTRAINTS & MOBILITY AIDS	J. BOHANNON	X	X		X			X
3 CREW HEALTH CARE	J. ELLIS		X		X			
4 OPS & PERSONAL EQUIPMENT	J. THOMAS/T. FLETCHER	X	X		X			X
5 PORTABLE EMERGENCY PROVISIONS	J. NOELKE	X	X		X			X
6 INTEGRATED WORKSTATIONS	D. JENSEN	X	X	X				X
7 GALLEY/FOOD MANAGEMENT	H. RIEMERS/C. BOURLAND	X			X			
8 PERSONAL HYGIENE	P. GROUNDS	X			X			X
9 ILLUMINATION	WHEELWRIGHT/JONES	X	X		X			X
10 WARDROOM	R. JONES/N. PAUSEBACK	X			X			
11 STOWAGE	J. LEW/J. MADIGAN	X	X		X			X
12 HOUSEKEEPING/TRASH MANAGEMENT	H. RIEMERS	X	X		X			X
13 INTERFACING PARTITIONS	R. JONES	X	X		X			X
14 IN-FLIGHT MAINTENANCE	F. MOUNT	X	X		X			X
15 INVENTORY MANAGEMENT	J. LEW/W. PRAUS	X	X		X			X



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SELECTED ACCOMPLISHMENTS

MAN-SYSTEMS DIVISION

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KC-135 ZERO G PROTOFLIGHT ANALYSIS

- SHOWER
- RESTRAINTS DESIGN EVALUATION

MAN-SYSTEMS INTEGRATION TEST BED

- WETF EVALUATIONS
 - UTILITY REEL/TRAY EVALUATION • EVA SUIT EVALUATIONS
 - TRUSS ASSEMBLY • AIRLOCK EVALUATIONS
- 1 G MOCKUPS
 - CUPOLA EVALUATION
 - INTERIOR DESIGN EVALUATIONS

PLAID

- VIEWING ANALYSIS
- ASSEMBLY SEQUENCE

INTEGRATION STANDARDS

- MAN-SYSTEMS INTEGRATION STANDARDS NASA STD 3000, VOL IV
- HUMAN COMPUTER INTERFACE GUIDE

INTERNAL ARCHITECTURE

- EXTENSIVE EVALUATION TO ESTABLISH BASIC LAYOUT
- DEVELOPED AND IMPLEMENTED MODULAR CONCEPTS



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TECHNICAL CHALLENGES	MAN-SYSTEMS DIVISION	
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**INTEGRATION OF MAN-SYSTEMS REQUIREMENTS
ACROSS ALL SPACE STATION FREEDOM ELEMENTS**